

Application Research on Cultivating Creative Literacy of Programming Courses in Higher Vocational Colleges Based on STEAM Model

Aiju Li, Chunguang Wang

*Shandong Transport Vocational College, Weifang, Shandong, 261206, China
aiju_li@126.com*

Keywords: STEAM, Innovation Literacy, Higher Vocational Programming Courses, Comprehensive Projects

Abstract: This paper introduces the application of Innovative Literacy Education in computer programming course of higher vocational colleges. Firstly, the realistic situational teaching model of innovative literacy is realized by dismantling realistic projects and reconstructing core basic curriculum content. Secondly, the innovative thinking is integrated into the following six basic steps: setting the situation, raising the question, independent exploration, cooperation-communication, summary-reflection, application and transmission. Finally, reform the evaluation method and establish a long-term mechanism conducive to the cultivation of innovation literacy.

1. Basis of Topic Selection

1.1 Background

Faced with the challenges of the information age and knowledge society, countries around the world have promoted scientific and technological innovation and innovative talent training to the level of national strategies and introduced a series of policies and measures. For example, the United States issued two reports, "Science and The National Interest" and "Technology and the National Interest". Japan has successively issued the first, second and third phases of "the Basic Plan for Science and Technology". The German Federal Government and the $\text{ix } \{911a\}$ der have ratified "the Top Research Grants Program" and "the Research and Innovation Agreement" [1]. These developed countries strive to enhance their overall national strength by implementing innovative development strategies.

General Secretary Xi Jinping has emphasized that "innovation is the soul of a nation's progress, the inexhaustible driving force for the prosperity of a nation, and the deepest national endowment of the Chinese nation" [2]. The CPC Central Committee and The State Council issued "the Outline of the National Innovation-Driven Development Strategy" in May 2016, which pointed out that education innovation should be promoted, talent training mode should be reformed, and the cultivation of scientific spirit, innovative thinking, creative ability and social responsibility should run through the whole process of education. We should foster a cultural environment that advocates

innovation and foster a culture of innovation that encourages creativity and pursues excellence throughout society. We should make promoting innovation an important part of the national spirit.

Gan Qiuling of Beijing Normal University proposed in the article "Innovation Literacy: 5C Model III of core Literacy in the 21st Century" that innovation literacy includes three elements: innovative personality, innovative thinking and innovative practice [3]. In the article "The Connotation and Implementation of innovation literacy from the Perspective of Core Literacy", Shi Baoguo, the first Normal University, defined the connotation of innovation literacy as innovation character and innovation ability. It is also proposed that "the implementation of innovative literacy in education and teaching should start from many aspects such as curriculum reform, teaching design and teacher development" [4]. There are many research papers on innovation literacy in basic education of primary and secondary schools, but relatively few in higher vocational education. Moreover, the research content mainly focuses on the framework construction, connotation definition and teaching case examples of innovation literacy, and the teaching reform or classroom reform to realize innovation literacy in professional courses of higher vocational education is still in the exploratory stage. In this paper, content reconstruction and comprehensive project teaching design reform in higher vocational program design courses are of great practical significance to explore the cultivation of students' innovative application ability, practical problem solving ability and ultimately innovation quality through real project teaching.

1.2 STEAM Model

STEAM refers to education related to Science, Technology, Engineering, Mathematics and Arts. STEM was first proposed in 1986 in the report "Undergraduate Science, Mathematics and Engineering Education" published by the National Science Committee of the United States [5]. Later, on January 11, 2009, the NATIONAL Committee of the United States released an open letter with the theme of "Improving Science, Technology, Engineering and Mathematics for All American Students", which opened the prelude of STEAM education and triggered the global STEAM education movement [6]. In 2015, UNESCO published a report, Rethinking Education: The Shift towards a "Global Common Good", which stated that "patterns of learning have changed dramatically over the past 20 years, the sources of knowledge have changed, and so have the ways in which we interact with knowledge. However, the formal education system changes slowly, and its current state is very similar to that of the past 200 years ", "designed to meet the production needs of more than a century ago" [7]. How to reverse the traditional education mode based on knowledge supply and consumption is the key to curriculum reform. In this context, all countries in the world regard curriculum as the fulcrum of education reform, and try to cultivate students' interdisciplinary quality through curriculum reform, so as to improve the quality of talent cultivation.

It is in this context that many schools in China actively carry out the local practice exploration of STEAM curriculum, aiming to promote the construction of interdisciplinary curriculum in China and strive to build a STEAM curriculum system with Chinese characteristics. However, from the perspective of current STEAM curriculum development in China, it is more about the transplantation of western STEAM curriculum concept and framework, and the lack of mining and research on local STEAM curriculum in China. Today, with the construction of high-quality education system and the realization of education power, how to focus on the global curriculum development trend, starting from China's own cultural tradition, based on the curriculum reform in China, to build China's local STEAM curriculum or even interdisciplinary curriculum system is an important issue.

Different from traditional subject-specific teaching, STEAM education model organically

integrates relevant courses and interacts with each other to form a knowledge system and apply it to practical problem solving. STEAM model advocates the following three core concepts :(1) emphasis should be placed on interdisciplinary and interdisciplinary knowledge integration in education and teaching, so that students can transform the fragmented knowledge of different majors into an interconnected and unified whole, so that they can understand the world and society from a complete and systematic perspective;(2) The cultivation of practical and innovative literacy should be integrated into practical problem solving, and the authenticity, complexity and multi-stage of problem solving should be emphasized. Authenticity means that the problems are similar to those students are likely to encounter in real life or in their future careers; Complexity means that solving problems involves a series of knowledge and skills such as observation, reasoning, gathering, sorting and analyzing information. Multi-stage means that questions, chapters and even textbooks do not necessarily provide all the information needed to solve the problem. Students need to do some research and make judgments and decisions based on the known information. Therefore, students need to spend some time to solve the problem. Through a large number of problems solved in this way, students can constantly find problems, solve problems and realize innovation in practice, which is conducive to students' formation of practical innovation quality; (3) STEAM pays attention to the diversification and multi-dimension of education. In the process of education, it pays attention to all students so that they can get due and useful education [4].

1.3 Topic Selection

Recently, Guangdong province and Jiangsu Province have made some achievements in promoting the "classroom revolution" in the field of higher vocational education, with some excellent cases emerging. The construction of vocational education highland in Shandong province is also in urgent need of professional teachers to conduct in-depth research on curriculum reform and classroom reform, so as to solve the problem of "the last mile" of higher vocational education teaching landing.

Based on the above national policies and theoretical research basis, and based on STEAM education model, this paper reconstructs the core basic curriculum content of the new generation of it professional group in higher vocational colleges, disassemble real projects to achieve situational teaching of cultivating innovative literacy. Taking innovation practice as the starting point, the innovative thinking class with six basic links is established. Reform the evaluation method and establish a long-term mechanism conducive to the cultivation of innovation literacy. This paper intends to explore the cultivation of innovative thinking, innovative application ability and innovative literacy of the new generation of it talents from the aspects of cross-specialty, cross-field, authenticity, complexity, stage and training of all students.

2. Research Content

In this paper, the teaching content is reconstructed for the new generation of IT majors in higher vocational colleges, including the programming courses of IT majors such as cloud computing, big data, Internet of Things, artificial intelligence and software technology. The research objects are the students majoring in cloud computing technology application and big data technology in our school. The professional basic courses of these two majors are: Web design and production, database technology and application, Java object-oriented program design, Java Web development practice, Wechat applets development and other professional basic courses. Although each course has its own curriculum standards, teaching syllabus, teaching objectives and key and difficult points, it is often relatively independent of each course, and each teacher is fighting for his own. These courses

are not integrated and designed as a professional series, and there are the following typical problems in teaching:

The content of the course is loose, the purpose of application is weak, and the content of the preamble course and the follow-up course is not well connected.

Too much scattered knowledge, unsystematic comprehensive projects, students lack the ability to solve problems in practice;

Simulation projects are the main ones, but actual combat projects are lacking, and the cultivation of applied thinking and innovative literacy is lacking.

In order to solve the above problems, this paper relies on the independent research and development of the enterprise real case "intelligent material Dispenser" comprehensive project, based on STEAM education model, based on the thick foundation and heavy application, to develop 9 sub-projects to achieve the situational teaching of innovation literacy; Taking innovation practice as the starting point, the innovative thinking class with six basic links is established. Reform the evaluation method and establish a long-term mechanism conducive to the cultivation of innovation literacy.

2.1 Implement the STEAM concept and disassemble real projects to achieve situational teaching of innovation literacy cultivation

"Smart material dispenser" comprehensive project comprehensive application of Web site, mobile APP, Wechat applets and other development skills, involving the knowledge of the above five courses, not only need students to have a solid foundation of knowledge, but also need students to use comprehensive knowledge, division of labor, independent learning to overcome the difficulties of innovative application ability, It is the STEAM teaching model that requires students to train their innovative personality and innovative thinking with an interdisciplinary, real project and real work scene, and cultivate their innovative ability in innovative practice.

At the same time, combined with the results of early teaching practice, develop stage projects that are conducive to cultivating students to lay a solid foundation and pay attention to practical application. On the basis of thick foundation and emphasis on application, boldly reform the key and difficult points of each course, delete or weaken the teaching of some knowledge, and increase the training of skills needed for engineering project development. In line with the STEAM teaching model, the authenticity, complexity and multi-stage training of all students' exploration spirit and innovative thinking.

(1) The comprehensive project of "Intelligent Material Dispenser" is decomposed into post skills according to the working process

"Intelligent material dispenser" is composed of intelligent material management system (MMS), intelligent material PCB board, intelligent welding rod distribution device, spanning the program design, mechanical design and manufacturing, electronic circuit design, embedded development and other professional. "Smart material management system (MMS)" shown in software design can be divided into information layer, data layer, business layer, layer, network layer, such as five parts, each part has different jobs skills required, across different professional course learning, is a cross major, complex and comprehensive real multi-stage coordination to complete the project, It is suitable for comprehensive project training of program design courses, which is helpful to cultivate students' innovative personality, innovative thinking and innovative quality in practical application.

(2) Divide "Intelligent Material Management System (MMS)" into stage projects according to software design, and refine the skills of the post, which can be applied to practical teaching.

2.2 With Innovative Practice as the Starting Point, Create Innovative Thinking Class with 6 Basic Links

In order to carry out the curriculum reform in the cultivation of innovative thinking, professional teachers should be familiar with the project cases, master the teaching methods of the project, and carry out the six basic links of "setting up the situation, raising questions, independently exploring, cooperating, exchanging, summarizing, reflecting, applying and transferring" to ensure the implementation of the teaching reform in the "last mile of teaching".

Therefore, school-based loose-leaf textbooks based on the above six links should be developed in the teaching resource development process of the 9 sub-projects in 2.1 to solidify school-based teaching resources, ensure that teachers can take real projects as the starting point of innovation practice, and cultivate students' innovative thinking, application ability and innovation quality.

2.3 Reform the Evaluation Method and Establish a Long-Term Mechanism Conducive to the Cultivation of Innovation Literacy

Evaluation is the baton of teaching. At present, there are two extreme orientations in the teaching practice of specialized courses in higher vocational education. The second is the "movement" of "only characteristics" and "only certificates" in cultivating students' accomplishment, which ignores the law of cognitive development.

The former does not pay attention to the training of thinking process and methods, and cannot help students to establish the understanding of professional connotation and professional problem solving ideas; Which is easy to "innovation" as the label, let students learn professional knowledge, a little knowledge in advance, let the students according to their to do some of the so-called innovation tasks, even under the "guidance" of teachers' personal production wide variety of innovative works, all kinds of innovation awards, create a dazzling "educational characteristic" and "education achievement". Innovation requires not only those epiphanies and storm bursts of inspiration, but also relaxed and calm rational thinking, and the perseverance to persevere in the face of setbacks and challenges.

This paper tries to reform curriculum evaluation approach in the process of innovation practice of work attitude, work efficiency, innovation, contribution to the team, social responsibility and so on to evaluate students' knowledge, skills, and give attention to the students' active learning, innovation, or works. At the same time, it also takes into account students' social responsibility, teamwork, dedication and other innovative personality. In the research and practice of the subject, further build and improve the way of student evaluation, and put forward a preliminary evaluation model.

2.4 Take Cloud Computing Technology Application and Big Data Technology as Examples to Conduct Empirical Research

Taking the two majors of Cloud computing technology application and Big Data Technology of Grade 2022 of our college as the pilot, we carried out empirical research, comparative analysis, dynamically adjusted teaching cases and teaching strategies, and continuously optimized summary and improvement.

3. Conclusion

This paper reconstructs the content of core professional basic courses. Carefully design project cases, with the project as the carrier and the application as the means, to cultivate students' software

development skills, innovative thinking, innovative awareness and innovative ability, so as to cultivate students' innovative literacy.

Acknowledgement

In 2020, the first batch of transportation digital network teaching resources co-construction and sharing topic –one of “Object-oriented Programming (Java)” online open course construction results

References

- [1] Lin Chongde. (2018). *Creative Psychology*. Beijing: Beijing Normal University Publishing Group.
- [2] Xi Jinping. (2013). *Speech by President Xi Jinping at the Celebration of the 100th Anniversary of the Founding of Western Returned Scholars Association*. Beijing: Xinhua.
- [3] Gan Qiuling. (2020). *Innovation Literacy: 5C Model of core literacy in the 21st Century*. *Journal of East China Normal University (Education Science)*.
- [4] Shi Baoguo. (2017). *The impact of STEAM education on students' innovation literacy and its implementation strategies*. *Chinese audio-visual education*.
- [5] Nan Gang. (2020). *Strive to build a STEAM course system with Chinese characteristics*. *Chinese Journal of Science*.
- [6] Hu Weiping. (2016). *Progress Report of Chinese Creativity Research*. Xi 'an: Shaanxi Normal University Press.
- [7] Lai, E. R., Yarbrow, J., Di Cerbo, K. & de Geest, E. (2018). *Skills for Today: What We Know about Teaching and Assessing Creativity*. London: Pearson.